

FLORA OF THE WOLF ISLANDS, NEW BRUNSWICK^{1 2}

PART 2

SOME PHYTOGEOGRAPHIC CONSIDERATIONS

ALBION R. HODGDON AND RADCLIFFE B. PIKE

In the earlier paper of this series (Pike and Hodgdon, 1963) we presented a list of the vascular plants of the Wolf Islands. With the addition, in a later paper, of 7 more species (Hodgdon and Pike, 1964) and one other in the present study, we now have a basis for comparing their flora with that of Grand Manan (Weatherby and Adams, 1945).

In this discussion we are emphasizing those rather numerous taxa which occur on the Wolves but which are not known from Grand Manan. Though it is true that certain of these may yet be discovered in the latter group of islands, many of the Wolf Island isolates are confined to certain special habitats such as sea-ledges and beaches where they would be conspicuous elements of the flora and thus would not be likely to escape notice. For example, *Conioselinum chinense* which is a prominent plant near the sea on all of the principal Wolf Islands was not discovered on Grand Manan during the many decades of careful botanizing of Weatherby and his predecessors. We also failed to find it or indeed most of the other Wolf Island specialties during several visits to Grand Manan, one notable exception however being *Betula papyrifera* var. *cordifolia* (Hodgdon and Pike, 1962). A

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pronounced difference in the relative abundance of certain taxa on the two groups of islands is shown by this birch, which is one of the most common trees on the Wolves but on Grand Manan is noticeably rare, and by *Amelanchier Bartramiana* which perhaps occurs on Grand Manan but whose presence there is indicated only by some intermediate individuals between the common *Amelanchier laevis* and *A. Bartramiana*.

Some remarkable and not easily explained deficiencies are to be noted in the flora of the Wolves. No species of *Typha* is found though habitats occur where it would seem that either *T. latifolia* or *T. angustifolia* could survive and spread. Both species occur on Grand Manan. No species of *Sparganium* nor indeed of any species of aquatic vascular plant of fresh water affinity has been found on the Wolves though there are a few brooks which on our numerous visits have always seemed adequate to support *Callitriche*. Neither *Juniperus communis* var. *depressa* nor *J. horizontalis* is found. This is surprising since conditions there seem to be suitable and both are to be found on Grand Manan. The genus *Spartina*, with three species on Grand Manan, is absent from the Wolves. In fact, nearly all of the characteristic salt marsh species of our coast are lacking though there are considerable areas on these islands where salt marsh species other than the commonly occurring *Juncus balticus* var. *littoralis* might be expected. Similarly, although the Wolves have a diversity of bog habitats and a fair representation of bog plants, two are absent there which are common on Grand Manan, *Rubus Chamaemorus* and *Gaylussacia dumosa* var. *Bigeloviana*.

We have been interested to detect pronounced floristic differences between two groups of islands lying fewer than fifteen miles apart, bathed by the same cold Bay of Fundy water and having a rather remarkable degree of apparent similarity in most other ecological features. Certainly the considerable group of islands comprising Grand Manan must be sufficiently diverse ecologically to provide environments comparable to those on the Wolves. How, then, do we account for the differences? It is this provocative question,

more than any other, that has led to our continuing study of these small islands.

In the list that follows we are including only the more clearly defined and less debatable taxa. Our 1963 list reflected a tendency on our part to subdivide species rather more than Weatherby and Adams, at least in some groups. However, whenever subspecific taxa are clearly defined and have long been recognized in the literature, it is assumed that they would have been listed in the flora of Grand Manan had they been found there.

We now feel, after a reappraisal, that a few taxa including *Botrychium simplex* var. *tenebrosum* and *Lycopodium annotinum* var. *alpestre* are better omitted from the Wolf Islands list. The former is probably typical *B. simplex* and the latter should perhaps be included with *L. annotinum* var. *pungens* although some of our specimens compare with extreme specimens of Alpine material from New Hampshire which some botanists have considered, perhaps erroneously, to be var. *alpestre*. In any event, more collections and more study both are needed before precise identifications in some groups seem warranted.

We are also omitting the following long persistent or adventive European plants from present consideration since we do not feel that their being absent from Grand Manan is germane to the present treatment of the relationship of the two island floras, *Rheum Rhaponticum*, *Capsella rubella*, *Senecio vulgaris* and *Hieracium pratense*.

SELECTED LIST OF VASCULAR PLANTS OF THE WOLF ISLANDS, UNKNOWN FROM GRAND MANAN.

Lycopodium annotinum L. var. *pungens* (La Pylaie) Desv.

In the Acadia University herbarium at Wolfville, Nova Scotia, there are specimens of this variety comparable to Alpine material that we have seen from the higher mountains of New England. These are from Cape Breton Island and from Cumberland and Guysborough counties in northern and eastern Nova Scotia. We have seen no typical specimens of *Lycopodium annotinum* on the Wolf Islands and some of the material is quite extreme. Some specimens, however, are difficult to classify having serrate, forwardly pointing or spreading and not reflexed leaves. Specimens are confined to East Wolf Island where considerable variability is shown presumably of genetic origin since the

plants grow under a fair range of environmental conditions and there seems to be no correlation of habitat with the character of plant. The question arises, how does one account for a genetically diverse population on one island and a total absence on nearby islands when in this instance more than one spore must have grown to maturity to initiate genetically distinct kinds of plants.

Ruppia maritima L. var. *longipes* Hagström

The var. *rostrata* is found on Grand Manan. On East Wolf, *Ruppia* occurs in two well separated ponds formed by barrier beaches. Since the varieties of *R. maritima* are very wide-ranging, probably there is no significance in the presence of any particular element of the species on the Wolves. It is of interest, however, that the Wolves and Grand Manan each have two or more colonies of a particular variety not shared with the other area; showing no recent migration of *Ruppia* between the two groups of islands.

Puccinellia laurentiana Fern. & Weath.

Plants of *Puccinellia* are both abundant and variable on all of the Wolves. A few large specimens fit the characteristics of *P. laurentiana* as given in Gray's Manual and match herbarium material of that species. While apparently absent from most of Nova Scotia, certain unnamed specimens from New Brunswick and adjacent Cumberland County, N. S., in the Acadia University herbarium, may belong to this species which otherwise is confined to the region about the Gulf of St. Lawrence and to northern New Brunswick.

P. paupercula (Holm) Fern. & Weath. var. *paupercula*

A number of specimens with small spikelets belong here. We have made very extensive collections of this abundant species most of which belong to the wider ranging and in eastern America more southern var. *alaskana* (Scribn. & Merr.) Fern. & Weath. Our material is extremely varied particularly as to stature and habit. The well-developed "bird lawns" around the edges of most of the Wolf Islands provide a suitable environment for a very extensive and varied growth of *Puccinellia* which with *Euphrasia*, which often grows nearby, constitute the most perplexing genera on the Wolves. The var. *paupercula* seems to have been collected no nearer than the Gulf of St. Lawrence and Cape Breton.

Agropyron trachycaulum (Link) Malte var. *glaucum*
(Pease & Moore) Malte

There may be nothing particularly unusual about the absence of this wide ranging taxon from the Grand Manan area. However, in Nova Scotia it has been collected up to now only from the following areas along the Bay of Fundy, Digby Neck to King's County, Cape D'or, Isle Haute and eastern Guysborough County into Cape Breton, a range that is somewhat more extensive in Nova Scotia than most of the other Wolf Island disjuncts but which nonetheless shows a distinctly northern type of distribution. This is perhaps the more inexplicable in view

of the fact that the generally more northern var. *majus* (Vasey) Fern. is found on both the Wolves and Grand Manan and occurs widely in Nova Scotia.

Deschampsia flexuosa (L.) Trin var. *montana* (L.) Ledeb.

In its more extreme phases this is one of the most distinctive of all the geographic varieties of various species that we have found on the Wolves. With compact inflorescences and large spikelets, these plants, which on the Wolf Islands at least are often stoutish, bear very little general similarity to typical *Deschampsia flexuosa* which also occurs on the Wolves. However, many intermediate and perplexing forms are present which are difficult to classify. This is a boreal variety whose southern limits, aside from the Wolves, seem to be St. Paul Island, Nova Scotia, and the mountains of eastern Quebec.

Calamagrostis canadensis (Michx.) Nutt. var. *robusta*

Vasey and var. *scabra* (Presl.) Hitchc.

All of our specimens of *C. canadensis* have big spikelets characteristic of these two boreal and montane varieties. The var. *scabra* would seem to be the more significant of the two. In the eighth edition of Gray's Manual (1950) it is recorded as extending on the southeastern part of its range to the Gaspé Peninsula and the White Mountains of New Hampshire while Dore and Roland (1942) specifically state that var. *scabra* has not been found in Nova Scotia. Weatherby and Adams recorded neither variety from Grand Manan and those specimens from there that we have seen are fairly typical *C. canadensis*.

Carex canescens L. var. *canescens* and

C. canescens var. *subloliacea* Laestad

The less boreal var. *disjuncta* Fern. is present on the Wolves but mostly is supplanted by these two varieties of more northern distribution and smaller or less separated spikelets. In Nova Scotia var. *subloliacea* apparently is very rare being represented from there only by a single collection from Cape Breton Island in the Acadia University Herbarium while var. *canescens* also seems to be confined to Cape Breton Island.

C. echinata Murr.

A most perplexing series of specimens has been collected on East Wolf Island grading into fairly clear *C. angustior* Mackenz. Many of these however are similar in most respects to *C. echinata*, a northern species that occurs south to Newfoundland and eastern Quebec. Some of the specimens in the folders of *C. angustior* in the Gray Herbarium from northern New England and New Brunswick also seem to be close to *C. echinata*. In view of the boreal character of the Wolf Island flora we may be permitted to suggest that our specimens show some introgression between these two species.

C. Emmonsii Dew.

One small colony of this relatively southern species was found growing in turf on a high ledge on the southern side of South Wolf

Island. It grows in Nova Scotia and Prince Edward Island and of course might be sought on Grand Manan.

C. crinita Lam. var. *crinita*

For Nova Scotia Roland (1945, p. 144), states "Scattered from Kings and Cumberland Co. to n. C. Br; . . ." In the eastern part of its range, var. *crinita* is apparently more northern than var. *gynandra* (Schwein.) Schwein. & Torr. which is found on Grand Manan. The range of var. *crinita* includes New Brunswick and Nova Scotia from Yarmouth and Kings Counties to Cape Breton.

C. nigra (L.) Reichard var. *strictiformis* (Bailey) Fern.

When first collected this was assumed to be *C. stricta* Lam. which it resembles superficially. It is quite distinct in appearance from typical var. *nigra* which also grows on the Wolves. This variety apparently overlies the southern part of the range in eastern North America of typical *C. nigra*. Being not particularly boreal it occurs around the periphery of Nova Scotia. Yet it seems to fit the pattern of more boreal taxa by missing Grand Manan.

C. rostrata Stokes var. *rostrata*

This variety whose spikelets have relatively short, broad and mostly acute scales seems to occur no nearer the Wolf Islands than northern Vermont, northern New Brunswick and St. Paul Island, Nova Scotia. Our limited collections of *C. rostrata* also include var. *utriculata* (Boott) Bailey. Our specimens of var. *rostrata* resemble rather closely the specimens we have seen from St. Paul Island collected by Perry and Roscoe in 1929.

Juncus effusus L. var. *Pylaei* (Laharpe) Fern.

This variety of the Common Rush with long, narrow unwrinkled spreading sepals is the only one we have found on the Wolves. In the Acadia University Herbarium no specimens of var. *Pylaei* were seen from western Nova Scotia which fact may be of some interest in relation to the plant's absence from Grand Manan. Two other varieties, *solutus* Fern. & Wieg. and *compactus* Lej. & Court., were reported by Weatherby and Adams from Grand Manan.

Luzula multiflora (Ehrh.) Lej. var. *acadiense* Fern.

In reference to var. *acadiense*, Roland (loc. cit. p. 167) states, "This plant originally described from P.E.I. is rather rare in the northern parts of the province. It is common and the only variety on Sable Island. A collection from St. Paul Island, originally referred to var. *comosa* is considered to belong here." Weatherby and Adams did not subdivide *Luzula multiflora*. Their material that we have seen, however, appears to belong to more wide ranging var. *multiflora*. The var. *acadiense* also is found as a component of the Passamaquoddy flora in Washington County, Maine, and mainland New Brunswick.

Salix pedicellaris Pursh var. *hypoglauca* Fern.

We collected a solitary specimen in a bog on East Wolf where it superficially resembled the abundant *Myrica Gale*. Since Mr. Weath-

erby in 1941 made the first discovery of this plant in Nova Scotia it would seem that he would have found it on Grand Manan had it grown there. In Nova Scotia it seems to be confined to the central counties.

Betula papyrifera Marsh. var. *cordifolia* (Regel) Fern.

In the Wolf Islands this variety is generally common while typical Paper-Birch has been seen only on East Wolf as very scarce specimens. The converse seems to be true of Grand Manan where by diligent hunting we found some specimens in 1964 though Weatherby and Adams had not seen any.

Geocaulon lividum (Richards.) Fern.

There are no specimens of this from Western Nova Scotia in the Acadia University Herbarium but a great many from Cape Breton and some of the eastern counties of Nova Scotia. It has been collected in Washington County, Maine, but otherwise is more characteristic of the northern New England mountains and northward.

Atriplex glabriuscula Edmondston

Weatherby and Adams mentioned the possibility that this species may be present on Grand Manan since it is known from Washington County, Maine and follows the coastline around Nova Scotia. However, *A. glabriuscula* seems to follow the pattern of many other boreal species by missing Grand Manan and appearing on the Wolves.

A. patula L. var. *patula*

No mention is made about the variability of *A. patula* on Grand Manan by Weatherby and Adams. We noted much variability on the Wolves, some specimens falling into var. *patula* by having the principal leaves linear to lance-hastate. Comparable specimens as clearly characterized as ours in the Acadia Herbarium are scarce and are from northern and eastern parts of Nova Scotia.

Ribes hirtellum Michx. var. *calcicola* Fern.

Plants of *R. hirtellum* are abundant on ledges and at the edges of woods on all the principal Wolf Islands. Extreme specimens with strongly pubescent and somewhat cordate leaves occurred on ledges next to the sea on Fatpot Island. The only collection of var. *calcicola* in the Acadia Herbarium from Nova Scotia was from Brier Island which is notable for having many stations of northern disjuncts.

Amelanchier Bartramiana (Tausch.) Roem.

This, the most northern, boreal and montane of our eastern Shad-bushes is found on South Wolf and perhaps also on East Wolf and Fatpot where presumed hybrids between it and *A. laevis* have been collected. Though it was not reported by Weatherby and Adams, it may be on Grand Manan since we found a putative hybrid population of *A. laevis* and *A. Bartramiana* there in 1961. On the other hand it is possible that we are witnessing here the swamping out of a species resulting from introgression of a rare species (*A. Bartramiana*) with a much more abundant one (*A. laevis*). It is well known that these

two species, while clearly distinct in certain habitats, cross very readily when their ranges come together. Some herbaria contain nearly as much hybrid material of these as there are specimens of the distinct species themselves. On Grand Manan the natural tendency to cross has been increased by the changes made by man on the vegetation and the habitat in general. Something similar may have happened to other taxa such as certain of those which now are found on the Wolf Islands and are absent on Grand Manan; certain populations of boreal affinity may once have been there but over the centuries have lost their identities through gene exchange with some compatible and more abundant population of more southern affinity.

The Wolf Islands, with clearly defined and probably relatively stable habitats, are likely to preserve specially adapted populations such as the boreal disjuncts we are concerned with in this paper, while Grand Manan with its greater wealth of habitats may not. In Nova Scotia *A. Bartramiana* seems to be confined principally to the northern and eastern counties.

Rubus pubescens Rab. var. *pilosifolius* A. F. Hill

Some of our specimens fall into this northern and western variety, having leaves velvety pubescent beneath.

Rubus idaeus var. *aculeatissimus* Regel & Tiling

It may seem bold to suggest that this well-marked northwestern American segregate in the *R. idaeus* complex occurs on the Wolf Islands but the plants under discussion have the glandular inflorescences of American *R. idaeus* and canes with stout and somewhat hooked prickles closely resembling herbarium material from the region of the Upper Great Lakes and farther west in North America.

Rubus idaeus L. var. *strigosus* (Michx.) Maxim

and *Rubus idaeus* L. var. *strigosus* forma *tonsus* Fern.

Here again are instances where the more southern elements of the species appear on the Wolves. We can only suggest that var. *strigosus* should be sought on Grand Manan. However, being bird islands, the extra fertility on the Wolves supplied by gulls undoubtedly has contributed most amazingly to the preservation and proliferation of a good sampling of the different recognized varieties and forms of the American raspberry. There are 5 morphologically defined varieties and forms of *R. idaeus* on the islands, each apparently distinct genetically and each of sufficient taxonomic or horticultural interest to have been given a name or to deserve one. Four of the five already have names; the fifth is the most distinct of all — a member of the var. *canadensis* group lacking bristles which is vigorous and fairly common, being found on several of the islands. Prickles and bristles seem to be very sparsely developed on most of the raspberry canes we have observed or collected on the Wolf Islands except for var. *aculeatissimus*.

Rubus idaeus var. **nesophilus** var. nov.

Forma typica similis, sed aculeis nullis.

Similar to *R. idaeus* var. *canadensis* but canes essentially without bristles. South Wolf Island, edge of shingle beach, August 15, 1960, *Hodgdon & Pike* no. 500 (holotype in University of New Hampshire herbarium (NHA)); Fatpot Island near shore, July 25, 1962, *Hodgdon, Pike, Denbow* and *Burns* no. 501 (NHA).

We cannot find any treatment of a completely bristleless raspberry of *R. idaeus* var. *canadensis* affinity in the literature. This segregate of *R. idaeus* has the characteristic glandularity of American raspberries along with a vestiture of close pubescence on the primocanes, and except for the total lack of bristles would be called var. *canadensis*. This clearly recognizable variety from the Wolf Islands, when considered strictly from the morphological standpoint, provides a pubescent counterpart of *R. idaeus* var. *strigosus* forma *tonsus* Fernald (1919). It is apparent from Fernald's brief discussion and citation of specimens that forma *tonsus* is an occasional variant lacking any well-defined range or particular habitat. Although Bailey (1945) later raised it to varietal rank, Fernald (1950) continued to treat it as forma *tonsus*. We are inclined to agree with Fernald about this taxon on the basis of available evidence but we feel that the bristleless plants of the Wolf Islands belong in the higher category of variety. They constitute an effective breeding population on at least three of the islands. We have collected this unique taxon on South Wolf and Fatpot and have seen it in some abundance on Flat Wolf where it is the predominant type of raspberry. There seems to be some interbreeding between bristleless plants and other populations of raspberry on the islands as shown by the variability of clones but in general var. *nesophilus* is maintaining itself. The bristleless plants possess a high degree of vigor and apparently compete successfully with other vegetation, including other kinds of raspberry. There may indeed be some adaptive genetic factor that favors these plants that lack bristles. A genetically distinct population which seems to be capable of perpetuating itself or even spreading in this somewhat unique environment better fits the category of *varietas* than *forma*.

It seems quite certain that var. *nesophilus* is a bristleless variant of *R. idaeus* var. *canadensis* Richards, and undoubtedly has evolved from it. Thus, we are placing the assumed derived taxon in the same rank as the supposed ancestor. This might be obviated by employing the rank of subspecies to include what now passes as var. *canadensis*.

The origin of our bristleless raspberry offers some problems. It is now sympatric with other raspberry populations with which it appears to hybridize to a certain degree. It may have evolved on these islands quite by itself and later came into contact with other raspberries, or, as in some other known Rubi, it may be a polyploid with a certain degree of but not complete genetic isolation from its

relatives. It is perhaps pure speculation to suggest that a bristleless raspberry would be more likely to succeed on islands apparently free from deer and most rodents than on the mainland or larger islands like Grand Manan.

Rubus vermontanus Blanch.

Three species of the Section *Eubatus* of *Rubus* are on the Wolves but each was found only once and in very limited quantity. On Grand Manan blackberries of several species abound. *R. vermontanus* is one of the more northern species, occurring like *R. canadensis* and *R. elegantulus* as far north as Newfoundland. On Grand Manan *R. vermontanus* may have contributed to some of the puzzling populations of blackberries probably hybrid in nature that have made that island a paradise for botanologists.

Lathyrus palustris L. var. *linearifolius* Ser.

Most of our collections of Vetchling, like that from Grand Manan, are the var. *pilosus* (Cham.) Ledeb. However, an occasional plant is nearly or quite glabrous. The var. *linearifolius* according to the range given in Gray's Manual of Botany, eighth edition, would hardly be expected in the Bay of Fundy area or in Nova Scotia but certain specimens in the Acadia University Herbarium from Cape Breton and eastern Nova Scotia resemble our material in having slender winged stems, narrow leaflets and in being quite glabrous.

Hypericum virginicum L. var. *Fraseri* (Spach) Fern.

This is entirely to have been expected on the Wolves. Weatherby and Adams (loc. cit. p. 57) make the following intriguing comment about the species on Grand Manan. "All the material we have examined, however, belongs with typical *H. virginicum*." Roland (loc. cit. p. 356) states of var. *Fraseri* in Nova Scotia, "is more common than the species and is perhaps the only form present eastward."

Viola lanceolata L.

The lance-leaved Violet may have been introduced into the much disturbed area near the lighthouse where it was found in an open and somewhat dry grassy area.

Epilobium nesophilum Fern. var. ***lupulinum*** var. nov. A forma typica foliis lanceolatis regularibus, apicibus obtusis acutis non attenuatis; calycibus 4.2-5.2 mm. longis, petalis albis differt; a var. *sabulonense* Fern. foliis angustioribus capsulisque pedicellatis 2 cm. longis.

Epilobium nesophilum var. *lupulinum* differs from the typical species in having regularly lanceolate leaves with apices bluntish to acute and not attenuate. Calyx length of 4.2 to 5.2 mm. is in the lowest part of the range to slightly below for the species. The height of the plants from 3 to 5 dm. falls in the low middle range of the species. The color of the petals is white as distinct from pink in the species description.

The var. *lupulinum* differs from var. *sabulonense* in having much

narrower leaves. The measurements of median leaves of ten specimens range from 25 to 37 mm. (av. 32.5 mm.) in length by 4 to 8 mm. (av. 6.3 mm.) in width. Pedicel lengths are from 4 to 21 mm., the latter being 6 mm. longer than the longest given for var. *sabulonense*. NEW BRUNSWICK: in sphagnum along small brook at northern end of East Wolf Island, July 27, 1962, *Hodgdon & Pike*, no. 1000, (holotype in University of New Hampshire herbarium (NHA)).

Epilobium nesophilum var. *lupulinum* is another variety of this island-loving *Epilobium* which is as distinct as the Sable Island variety described by Fernald (1918). We found a colony of this interesting segregate growing in wet sphagnum along a small brook near the northern end of East Wolf Island, New Brunswick. While the Wolf Islands are not as remote geographically as Sable island, they display some evidence of biological isolation which would have allowed similar evolutionary mechanisms to function in the production of a distinct insular form. Probably not more than fifty plants were present of which we collected ten representative specimens. The small size of this population and the restricted habitat, along with the isolation of the islands themselves, would indicate a closely inbreeding group. Such conditions would offer a favorable opportunity for the appearance and fixing of the genetic characters of either adaptive or nonadaptive significance which make this a distinct variety. It being quite unlike any other *Epilobium* with which we were familiar, we have only recently identified our material and in fact have not included it in any of our published lists.

In carefully scrutinizing the very few brooks which occur on the Wolves in the expectation that we might disclose interesting aquatic or subaquatic plants, we have seen no other colony of this variety and it is entirely possible that this one small group represents the entire population. Without much doubt, here is an instance where the Sewell Wright effect might be invoked as an explanation of this variety. At least it would be hard to see how such differences as are shown between this variety and the remainder of the species could have survival value.

In addition to the purely taxonomic interest of this particular find, it also represents a considerable extension of range for the species. Previously, *E. nesophilum* has been found in Newfoundland, the Magdalen Islands, Anticosti Island and Sable Island and thus further emphasizes the boreal character of the Wolf Island flora.

Conioselinum chinense (L.) BSP.

It was the abundance of Hemlock-parsley on all the wooded Wolf Islands and the lack of it on Grand Manan that more than any other single factor led us to a detailed study of the two groups of islands. It is a common and perfectly obvious species growing at or near the edges of woods above sea ledges or beaches, often within reach of sea-spray, and, as depauperate individuals, sometimes found in cracks and

crevices of ledges. In Nova Scotia it is known along the edge of the Bay of Fundy, on St. Paul Island off Cape Breton, and in a few localities in eastern Nova Scotia. Except on St. Paul Island it is stated by Roland to be scarce. No mention is made by Fernald in Gray's Manual, edition 8, of a coastal type of habitat for *Conioselinum*. Yet it is evident from data on herbarium specimens that in the more coastal part of its range it often frequents habitats similar to those on the Wolves — rocky coast, sea-cliffs or ledges near the sea.

Vaccinium Oxycoccus L. var. *ovalifolium* Michx.

Weatherby and Adams recorded *V. Oxycoccus*, not specifying any variety, on Grand Manan. Roland, treating it as var. *intermedium* Gray, stated that it was rare in Nova Scotia. On the Wolves it is perhaps more abundant and certainly more conspicuous than the more narrow-leaved var. *Oxycoccus*. In fact, for some time we assumed that all of the Wolf Island material belonged to the broader leaved type.

Lomatogonium rotatum (L.) Fries var. *americanum*
(Griseb.) Fern.

Our station for this on South Wolf seemed for a while to be the only one between Schoodic Peninsula on the Maine Coast and the Magdalen Islands. The recent discovery of it on two islands in Washington County, Maine, (Pike 1963) expands the range into the Passamaquoddy area. This is further evidence to show that the Wolf Islands contain an integral part of the Passamaquoddy flora.

Euphrasia canadensis Townsend

The Eyebrights deserve a special study on the Wolves. They are exceedingly common in open situations, particularly on bird-lawns and in woods openings. The small flowered *E. Randii* Robins. is highly variable and common while the larger flowered *E. canadensis* and *E. americana* Wettst. are even more abundant. We have collected extensively of these variable populations and find them difficult to classify. Ecological variability in particular seems to be considerably greater than is indicated in most treatments of the group. *E. canadensis* was not reported from Grand Manan nor any varieties of *E. Randii*.

Plantago juncooides Lam. var. *glauca* (Hornem.) Fern. and

Plantago juncooides Lam. var. *laurentiana* Fern.

Most of the plants we have seen of *P. juncooides* belong to var. *decipiens* (Barn.) Fern. Locally on East Wolf Island we found tiny plants with abbreviated spikes conforming to var. *glauca*. Some plants on South Wolf with very long and wide leaves, representing the other extreme of size, fit var. *laurentiana*. These varieties are found in northern and eastern Nova Scotia. The var. *glauca* extends southwestward into eastern Maine. Both varieties are unreported from Grand Manan.

Galium labradoricum Wieg.

When we saw this species for the first time in a bog on East Wolf

Island we were struck by its stiff and erect though slender branches quite unlike any *Galium* with which we were familiar. It is a species of northern affinity of apparently somewhat scattered occurrence in Coastal Maine and greater abundance farther north and west. In the Acadia University Herbarium there are Nova Scotian specimens from Cape Breton.

Lonicera villosa (Michx.) R. & S. var. *Solonis* (Eat.) Fern.

This is the common variety of *L. villosa* on the Wolves where it occurs in some abundance on East Wolf Island. Grand Manan had var. *calvescens* (Fern. & Wieg.) Fern. and var. *tonsa* Fern. which also is found on East Wolf, though less commonly than var. *solonis*.

Aster umbellatus Mill. var. *pubens* Gray

There is a wide range of variability in *A. umbellatus* on the Wolf Islands. In general it is a very common species, particularly whenever the substrate has been fertilized by gulls. Part of the variability may almost certainly be a direct response to the environment. Certain extreme forms, however, are not to be explained this way. They have the characters given in the eighth edition of Gray's Manual for var. *pubens*, including the upper surfaces of leaves and upper parts of stems scabrous, leaves tomentulose beneath, phyllaries acutish, pubescent on the back, etc. We have collected var. *pubens* on three of the Wolf Islands. This variety seems to be western with a range somewhat comparable to that of *Rubus idaeus* var. *aculeatissimus*, getting about as far eastward as Michigan.

Anaphalis margaritacea (L.) Benth. & Hook.
var. *subalpina* Gray

This variety is mostly western and northern in distribution. It is apparently common on Sable Island but apparently does not occur otherwise in Nova Scotia (Roland loc. cit. p. 501). Some of our specimens seem to belong here. Probably the others should be identified as var. *angustior* (Miquel) Nakai.

Achillea borealis Bong.

Yarrows are common and, like *Aster umbellatus*, *Aster foliaceus*, *Rubus idaeus* and several other species of herbaceous plants, grow most luxuriantly in gull infested sections of the Wolves. Plants of yarrow become disproportionately large and defy identification. We have made a careful study of our fairly numerous collections. On most specimens the phyllaries are dark-margined and some specimens on each of the islands fall within the range of characteristics of *A. borealis*. As a whole the plants are difficult to classify and perhaps in general represent an introgressed series with *A. lanulosa* Nutt. or *A. Millefolium* L.

GEOGRAPHIC RELATIONS

Weatherby and Adams attempted to show the more readily apparent phytogeographic relationships of the Grand Manan

flora by setting up categories of species having similar patterns of distribution. Three of their groupings embracing 22 species, 10 of which are shared with the Wolves, are of boreal or nearly boreal affinity. Since some 33 of the Wolf Island disjuncts that we have discussed in this paper are similarly of boreal or subboreal character we find that a total of 43 Wolf Island taxa are boreal as against 22 from the Grand Manan group. The two island groups together have 55 taxa of northern affinity, of which the Wolves have 78% and Grand Manan only 40%. Assuming that there are some inadequacies both in collecting and interpreting the plants of one or both groups of islands, we are confronted nonetheless with a considerable difference between them that can hardly be shrugged aside. Both groups of islands have been botanized rather closely and critically, Grand Manan by a number of botanists over a long period of time and the Wolves very intensively in recent years by ourselves. Our goals have been to compile a complete list of its vascular plants and to get a sampling of variability in its taxa whenever it seemed warranted. We can state with assurance that the boreal varieties of species complexes are at least as abundant in most cases as their more southern counterparts. In fact, in our collecting on the Wolves we have had to search more diligently for the southern than for the boreal varieties. The disparity between the Wolves and Grand Manan therefore would not seem to result from any bias in collecting. Moreover, we feel that, quite aside from the list and what it reveals, the vegetation of the Wolf Islands has a boreal aspect.

It is evident then that our main phytogeographic problem relates to this remarkable concentration of boreal species and varieties on the Wolf Islands. Under the discussion above of *Amelanchier Bartramiana* we tried to show how one species of greater abundance, *A. laevis*, may have absorbed or swamped out another genetically compatible and more boreal species, *A. Bartramiana*, when conditions were suitable. Some other of the boreal species on the Wolves are parts of species complexes that have presumably compatible

and more southern elements on Grand Manan. In theory it would have been possible for these more boreal populations to have existed on Grand Manan in the past and subsequently to have been absorbed into the more southern populations. On a fairly large island mass the presence of relatively larger populations of the latter (warm) type may well have speeded the introgression. Also the effects of climatic change may have been much more pronounced on large and relatively high islands than on the Wolves. The climatic optimums of recent geologic time thus may have eliminated some boreal taxa from Grand Manan while the Wolves still would have much more closely reflected the stabilizing and somewhat refrigerating influences of the Bay of Fundy. In this way we might account for some of the differences between the two areas, considering, for example, complex species like *Calamagrostis canadensis* or *Carex canescens* with integrating and presumably interbreeding varieties. Perhaps also the differences in *Amelanchier* and the *Rubus idaeus* mélange can be explained in this manner. However, a considerable number of characteristic boreal specialties of the Wolves, such as *Galium labradoricum*, *Salix pedicellaris* var *hypoglauca*, *Geocaulon lividum*, *Atriplex glabriuscula*, *Conioselinum chinense* and *Lomatogonium rotatum*, to name but the more striking examples, should have persisted on Grand Manan in the usual habitats if they had ever been there. Ecologic change can hardly have eliminated all of these and it would seem that they would hardly have lost out by exchanging genes with anything else. It would seem that these are fully as suited to the Grand Manan area as to the Wolves. Something of a pattern of distribution is suggested involving not only these but quite probably a major part of the Wolf Island disjuncts — a pattern that relates to connections to the mainland. The Bay of Fundy between the Wolves and the Coast of Maine and New Brunswick is shown on hydrographic charts as being somewhat more shallow than it is between Grand Manan and the Wolves or between Grand Manan and the Coast of Maine and New Brunswick. We suggest that the boreal disjuncts of the Wolves, in part

at least, represent a residual flora which came overland or essentially so from what is now the Maine and New Brunswick areas (Mainland Passamaquoddy) at a different time from any migration overland to Grand Manan and this fact in part accounts for the close affinity of the flora of the Wolves to the mainland. Grand Manan on the other hand must have been connected at some other time or in some other way to the mainland and presumably also derived a considerable part of its flora from the region of Western Nova Scotia. Post-Pleistocene history is not revealed clearly enough to any more than suggest this hypothesis. But other studies that we have in progress involving other islands in the Bay of Fundy, such as Isle Haute, show quite clearly the necessity of a land connection to have provided a route for certain species of the present flora to have reached that island.

Whatever may have been the migrational history of the areas under scrutiny only those species will persist which can adjust to the local environmental regime and changing conditions.

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LITERATURE CITED

- BAILEY, L. H. 1945. *Gentes Herbarium* 5, fasc. X: 870.
- DORE, W. F. and A. E. ROLAND. 1942. The Grasses of Nova Scotia. *Proc. Nova Scot. Inst.* XX, Part 4: 241.
- FERNALD, M. L. 1918. *Rhodora* 20: 31.
- . 1919. *Rhodora* 21: 96-97.
- . 1950. *Gray's Manual of Botany*. 8th Ed., Amer. Book Co., N. Y.
- HODGDON, A. R. and R. B. PIKE. 1963. The Flora of the Wolf Islands, New Brunswick. Part 1. *Rhodora* 65: 82-96.
- . 1964. Additions to the Wolf Islands Flora, 1963. *Rhodora* 66: 61-62.
- PIKE, R. B. 1963. *Rhodora* 45: 364-366.
- ROLAND, A. E. 1945. The Flora of Nova Scotia. *Proc. Nova Scot. Inst.* XXI part 3.
- WEATHERBY, C. A. and J. ADAMS. 1945. List of the Vascular Plants of Grand Manan. *Contr. Gray Herb.* CLVIII.